Ann Arbor Statement

February, 2004

Resulting from:

Great Lakes Binational Toxics Strategy

Long Range Transport Workshop:

The Atmospheric Pathway of Toxic Substances to the Great Lakes

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DELTA INSTITUTE

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The Ann Arbor Statement
February 2004

Introduction:

In September 2003, a group of over 70 scientists and policy makers met in Ann Arbor, Michigan, to discuss the long-range atmospheric transport of persistent, bioaccumulative and toxic substances (PBTs) to the Great Lakes Basin. This Statement recommends actions to better understand and reduce the impacts of the long-range transport of these chemicals.

While considerable progress has been made in decreasing contamination in the Great Lakes Basin, PBTs remain at levels that pose threats to human and ecosystem health. Long-range atmospheric transport, at the regional, continental, hemispheric, and even global scale, is a significant contributor of some of these pollutants, and unless long-range transport issues are addressed, the Great Lakes Water Quality Agreement (GLWQA) goal of virtual elimination will not come into reach. There remain important gaps and uncertainties in our scientific understanding of the sources and the transformation and transport processes that control the environmental levels of PBTs. Resolving these scientific uncertainties is required for making wise policy decisions to further reduce pollutant concentrations, exposures and impacts. The discussion and deliberation in Ann Arbor resulted in a set of recommended actions to improve long-range transport science and to better inform policy. These actions, which are presented in Appendix A as some 60 specific research needs, fall into four categories and are summarized as follows.

Necessary Actions:

Emissions Inventories

Canada and the United States must improve, coordinate and disseminate, in a more timely fashion, emissions and usage inventories of PBTs. Priority actions include standardizing estimation techniques, characterizing poorly understood sources, and improving the review and accountability of inventories. These efforts must be coordinated not only within the Great Lakes Basin but also on a continental and even global scale with the assistance of continental and international organizations.

Monitoring

Improved coordination, harmonization of chemicals and methods, effective data sharing, and enhanced data analyses must become immediate priorities for PBT monitoring. The successful Integrated Atmospheric Deposition Network (IADN) program should continue with a focus on these and other priorities including improved expert review, inclusion of emerging substances of concern, more timely dissemination of results, and incorporation of new and emerging technologies such as passive air samplers. Stations should also be set up to monitor inter- and intra-continental transport to and from the Great Lakes watershed basin.

Modeling

The full benefits of emission inventories and monitoring can only be realized if the results are used in modeling assessments which seek to: establish a complete mass balance or budget; calculate rates of transport to and from the Great Lakes basin; identify sources and/or source regions responsible for transport to the basin; and understand cross-media fluxes between air, water, soils, sediments and biota. Uncertainties regarding mercury must receive focused attention. Furthermore, an international modeling initiative is required in which various modeling approaches are tested, compared and coordinated and the findings presented to the lay public in a compelling and understandable format.

Integration and Synthesis

In order to fill the knowledge gaps and more efficiently use existing resources, future efforts should focus on coordinating emissions inventory, monitoring, and modeling efforts and improving accessibility and comparability of data and methods. International scientific cooperation is critical, as is support from stakeholder groups, including non-government organizations, academic institutions, and industry. Long-term funding commitments are necessary to improve our scientific understanding of the long-range transport of PBTs. To secure the required funding, scientists must work together to effectively communicate to the general public the linkages between understanding long-range transport and protecting public health and environmental quality.

Conclusion:

The U.S. and Canadian governments, in cooperation with international agencies, need to enhance initiatives to better understand the long-range atmospheric transport of toxic substances. If the Great Lakes Basin continues to be a sink and source of air toxics, the goals and objectives of the GLWQA will never be realized, and environmental levels of toxic pollutants will continue to compromise the health of our ecosystem and its inhabitants. Significant financial and human capital will be required to coordinate and implement the critical actions summarized above, and detailed in Appendix A, in order to understand and ultimately control the long-range transport of toxic chemicals to the Great Lakes Basin.

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Appendix A: Necessary Actions

I. Actions Concerning Emissions Inventories

1. **Coordinate emissions inventory development with modeling and monitoring efforts.**
   a. Harmonize pollutant lists.
   b. Include modelers in the development of emissions inventories.
   c. Improve the transparency of and access to emissions inventories among researchers.

2. **Develop and maintain a coordinated North American continental inventory for PBTs.**
   a. Facilitate coordination of this inventory through the Commission for Environmental Cooperation (CEC).
   b. Collect and maintain validated emissions inventories of PBTs; support states and provinces in this effort.
   c. Develop improved PBT emission inventories in Mexico, with the assistance of the CEC.

3. **Identify and quantify the emissions of PBTs from poorly understood sources and incorporate this information into emissions inventories.**
   a. Include priority sources such as small diffuse urban sources, open burning, and natural sources.
   b. Conduct additional research on the re-emissions of PBTs – particularly mercury and pesticides – from soil, water, and plant surfaces to determine flux estimates to the atmosphere.
   c. Improve the speciation and congener profiles of PBT emissions among source sectors.

4. **Improve the review and accountability of inventories.**
   a. Standardize measurement and estimation techniques to minimize inconsistencies in emissions, usage, and residue inventories.
   b. Conduct external peer reviews.
   c. Promote the release of emissions inventories in a timely manner.

5. **Improve mercury emission inventories.**
   a. Improve the understanding of mercury speciation among source sectors.
   b. Improve the understanding of co-emitted pollutants (and tracers) for use in source signature profile analyses.

c. Identify and characterize sources of methylmercury measured in wet deposition sampling.

6. **Develop standardized pesticide usage, emissions, and inventories for current-use and banned substances.**[1]
    a. Develop global emissions, usage and residue inventories for aldrin/dieldrin, chlordane, mirex, hexachlorobenzene, endrin, heptachlor (and heptachlor epoxide), and gamma-HCH with a particular focus on Mexico and Central America.
    b. Collect pesticide-use information in order to create pesticide-use databases.

7. **Develop hemispheric and global inventories for PBTs.**
    a. Coordinate with efforts to implement the Stockholm Convention obligations to quantify persistent organic pollutants (POPs) sources.
    b. Aid developing countries so as to improve emissions inventories; focus on major contributors.[2]
    c. Encourage other countries to collect pesticide-use information in order to create pesticide-use databases.
    d. Provide support and incentives to developing countries regarding pesticide usage and potential cost-effective, yet functional alternatives.

<u>II. Actions Concerning Monitoring</u>

1. **Coordinate monitoring efforts with emissions inventory development and modeling efforts.**
    a. Include modelers in the development of monitoring data.
    b. Develop baseline conditions for chemicals monitored.
    c. Identify and characterize sources and/or source regions.
    d. Use monitoring data to check accuracy of emissions inventories.

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[1] Pesticide emission inventories developed by Li et al. have been extremely useful for identifying important source regions to the Great Lakes. For example, a modeling analysis by Ma et al. 2003 shows that lindane usage in the Canadian plains is more significant than in-basin usage of lindane to total loadings to the Great Lakes.

[2] While North American and European mercury emissions have decreased over the past decade, mercury emissions in Asia and Africa and South America are increasing. Three-quarters of total 2000 mercury emissions due to combustion of fossil fuels particularly coal combustion in China, India, and North and South Korea. Asian countries are responsible for about half of total global anthropogenic mercury emissions.

e. Focus on understanding pollutant transport processes (e.g., air/surface exchange, urban plumes).

2. Harmonize monitoring methods; improve data sharing; improve access to data.

a. Conduct intra- and inter-monitoring network comparisons to better understand transport and transformation mechanisms and to confirm the accuracy of individual networks.
b. Synchronize sampling intervals for special long-range transport studies.
c. Establish monitoring networks that cross political boundaries – coordinate with other international efforts, e.g., the United Nations Environmental Programme (UNEP) POPs monitoring program.

3. **Improve data analysis.**

a. Improve our understanding of chemical transport and fate by focusing on specific components/congeners of complex chemical mixtures and classes.[3]
b. Conduct detailed analyses of existing databases to examine intra- and inter-annual variability, as well as spatial variations in chemical concentrations, to better understand both chemical behavior and the influence of sources.

4. Perform a rigorous assessment of passive samplers in order to complement other networks.[4]

a. Focus on significant source regions, especially those with severe infrastructure and technical support constraints.
b. Further improve techniques and understand limitations.

5. Pursue new monitoring methods and add mechanisms for monitoring new substances.

a. Conduct separate vapor and particle phase analyses to better understand a substance's gas-particle partitioning.
b. Conduct concurrent measurements of new chemicals in air, water, fish, humans, etc. to quantify exposure and risks.

[3] For example, congener analyses has shown that PCBs in the Arctic are a result of current use (primary emission) and that past-use PCBs remain in the soils of the northern hemisphere's temperate regions.

[4] Passive samplers offer an inexpensive method to improve spatial resolution of toxic substances in the atmosphere.

c. Improve methods to measure and understand the dry deposition of mercury and other POPs to the Great Lakes through the processes of plant up-take, throughfall and litterfal.[5]
d. Conduct highly intensive sampling studies (i.e., measure levels of PBTs, criteria pollutants, and trace elements at short sampling intervals) with newly available technology, in order to identify source-receptor relationships.
e. Expand Great Lakes monitoring data to include the current-use pesticides (e.g., endosulfan, lindane, atrazine), dioxins/furans, reactive gaseous mercury, PBDEs, and other emerging contaminants.

6. **Develop sentinel sites to assess inter- and intra-continental transport.**

   a. Conduct a more detailed assessment on the appropriateness of Hawaii as an indicator of trans-Pacific transport from Asia to North America. Consider whether a sampling site on the Aleutian Islands, Alaska, might be more appropriate.
   b. Add POPs to the sampling site at Mauna Loa, Hawaii, if supported by the above assessment.
   c. Add sentinel sites to assess the importance of transport from Central America and Mexico, and trans-Atlantic transport, using similar data/analyses from general global circulation models.

7. **Take advantage of opportunities to enhance the Integrated Atmospheric Deposition Network (IADN).**

   a. Use modeling analyses to relocate and/or add sampling stations.
   b. Promote timely access to monitoring data.
   c. Include additional monitoring parameters such as: mercury speciation data; event precipitation; urban and source region characterizations; dry deposition; aerosols and trace elements; and emerging chemicals.
   d. Coordinate with other monitoring networks.

III. Actions Concerning Modeling

1. **Coordinate and integrate modeling analyses with emissions inventory development and monitoring efforts.**

   a. Link emissions, observations, atmospheric modeling, aquatic and food chain modeling.

[5] Recent research suggests that dry deposition of mercury may be equal or exceed wet deposition. Currently, only wet deposition is being monitored on a routine basis underestimating mercury deposition by 50 percent.

b. Demonstrate such linkages to highlight impacts on local ecosystems and communities.
c. Utilize models as predictive tools.

2. **Improve the reliability of model estimates of contributions from different scales.**
   a. Use model inter-comparisons to evaluate a number of different models when sufficient monitoring data is unavailable.
   b. Pursue a regional mercury model inter-comparison study, similar to the European Monitoring and Evaluation Program (EMEP) mercury models intercomparison study currently underway, to improve accuracy and reliability of mercury deposition estimates to the Great Lakes.
   c. Use models of varying levels of complexity.[6]
   d. Include sensitivity and uncertainty analyses in modeling results.

3. **Encourage North America researchers and EMEP to participate in one another's mercury/POPs model inter-comparison studies on a global and regional scale.**
   a. Use new models to simulate the long-range transport and cross media transfers ("grasshopping") of POPs on both the continental and global scales.[7]
   b. Use multi-compartment mercury models to simulate the long-range transport of mercury and its long-term accumulation in ecosystems and re-emission to the atmosphere.

4. **Increase our understanding of the transport and fate of PBTs and mercury.**
   a. Improve our understanding of deposition processes, particularly dry deposition to water, soils and vegetation.
   b. Improve our understanding of volatilization processes from water, soils and vegetation
   c. Focus on the atmospheric chemistry of mercury including the chemical composition of reactive gaseous mercury (RGM).
   d. Improve understanding of the transport of chemicals in the atmosphere including troposphere/stratosphere exchange and convective transport.

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[6] Screening level models can be used to assess the long-range transport potential of substances to the Great Lakes. Semi-volatile substances with gas-phase transport and diffusive deposition are suspected as having the highest long-range transport potential.

[7] One such model (Berkeley-Trent model) was used to identify important North American source regions to toxaphene in the Great Lakes. Similar analyses are needed for other substances.

IV. Integration and Synthesis: Coordinate resources, methodologies, and availability of information for long-range transport research.

1. **Leverage resources.**
    a. Make direct links with environmental, social, and economic priorities such as: ecosystem impacts, human health, environmental justice, regulations, emerging issues, and indirect societal costs.
    b. Seek industry support.

2. **Utilize existing resources and programs to maintain and expand research.**
    a. Take advantage of interest in emerging chemicals in order to emphasize importance of research on "traditional" chemicals.
    b. Promote, where useful, cross-fertilization of air toxics-related activities with work on long-range transport of other pollutants (e.g., particulate matter, ozone).

3. **Improve access and transparency of information for researchers, decision-makers, general public.**
    a. Develop a long-range transport network for the Great Lakes region.
    b. Communicate to high risk populations in layman's terms via the internet, news media, and other means of outreach.

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Appendix B: Planning Committee
Long Range Transport Workshop

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